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Optimizing conventional breast cancer chemotherapy using combinations of nano-drug delivery systems

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Background: Gold nanoparticles (AuNPs) can be used as delivery vehicles for platinum anticancer drugs, improving their targeting and uptake into cells. Cisplatin, cis-diamminedichloridoplatinum (II), is the leading metallodrug used in the systemic treatment of solid tumors. Its clinical use is limited by severe toxic side effects, attributed to the indiscriminate accumulation of the drug in both normal and cancerous tissue, its nonspecific interactions with extra- and intracellular proteins, and drug resistance, both intrinsic and acquired.

Aim: The aim of the current study is to evaluate both *in vitro* and *in vivo* anti-tumor efficacy of gold nanoparticles (GNPs) conjugated with conventional chemotherapy drugs for the treatment of breast cancer.

Methods: GNPs were successfully used as a complex tumor-targeting drug-delivery system. The drug cisplatin was non-covalently conjugated onto the hydrophilic assemblies of GNPs-nanostructure. Transmission and scanning electron microscopy were used to characterize the morphological and structural properties of these drug-metallic nanostructures. The effect of GNPs was tested *in vitro* in cancer cell lines and *in vivo* model for cancer.

Results: The cancer cells toxicity and viability in the presence of the anti-cancer drugs delivered by the GNPs were found to be statistically more than those of cells exposed to the traditional cancer drug alone, indicating that GNPs facilitated an increased susceptibility of cancer cells to cisplatin. Relative tumor volume (RTV) of animals treated with cisplatin and cisplatin-nanogold are significantly lower than controls. At day 24 post treatment with cisplatin and cisplatin-nanogold conjugate indicated that cisplatin-treated group has their RTV continuously increased while animals treated with cisplatin-nanogold has their RTV continuously decreased. Histologically, the tumor cell density of cisplatin-nanogold conjugate -treated animals are less than those treated with cisplatin alone.

Conclusion: This pilot study could offer a new chemotherapy strategy for patients diagnosed with breast cancer. The late effect of cisplatin-nanogold on RTV at day 24 could be a significant chemodynamic of the drug on tumor eradication.

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